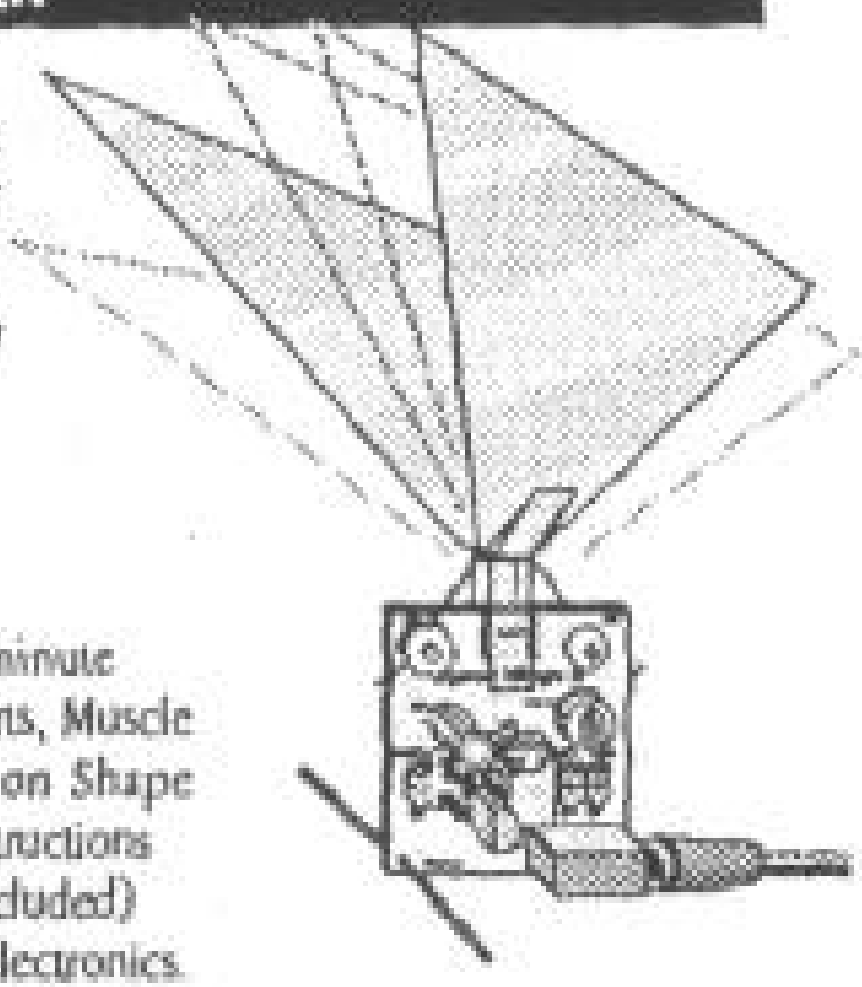
Space Wings I™

Moving Electronics Kit



Space Wings demonstrates the amazing capabilities of Muscle Wires®, thin metal filaments that actually *SHORTEN IN LENGTH* when powered!

- Silent, graceful motion
- Stands 15 cm (6 in.) tall
- Adjustable: 6 - 36 cycles per minute
- Includes circuit board, all parts, Muscle Wire, history and information on Shape Memory Alloys, and complete instructions
- Uses two AA batteries (not included)
- An excellent introduction to electronics.

Easily assembles in under an hour. You will need: soldering iron for electronics, solder, needle nose pliers, side cutter, small Phillips screwdriver, hobby knife, straight edge ruler, transparent tape, two AA batteries (or 3 Volt DC adapter). Electronics experience helpful but not required.

Made in the U.S.A. by Mondo-tronics, Inc.

1 - Introduction

The Space Wings Kit demonstrates the amazing capabilities of Muscle Wires®, thin metal filaments that actually SHORTEN IN LENGTH when electrically activated. Review these instructions to become familiar with the parts in the kit. If you have not assembled electronics before, read Section 5 to learn about soldering.

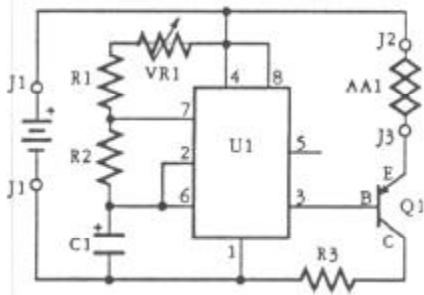
Bill of Materials - As you assemble the parts, refer to the list below and the instructions. Each item is indicated by its part number and location code.

	Loc.	Qty	Unit	Description
1)	-	1	ea	PC Board, Space Wings, Rev C
2)	R1, R2	2	ea	Resistor, 75KΩ, 1/4W, 5% (Violet, Green, Orange, Gold)
3)	R3	1	ea	Resistor, 1.6Ω, 1/4W, 5% (Brown, Blue, Gold, Gold)
4)	U1	1	ea	Socket, 8 pin, DIP
5)	VR1	1	ea	Variable Resistor, 1MΩ, 1/4W, 5%
6)	C1	1	ea	Capacitor, 10µf, electrolytic, radial
7)	J1	1	ea	Jack, Mini, 2.5 mm
8)	Q1	1	ea	Transistor, PN2907, PNP
9)	J2, J3	2	ea	Screws, 4/40, 1/4", pan head, phillips, zinc
10)	J2, J3	2	ea	Nut, Hex, 4-40
11)	Stand	1	ea	Stand Wire (a paper clip)
12)	U1	1	ea	Integrated Circuit, TLC555CP, 8 pin, DIP
13)	J2-J3	6	cm	Muscle Wire, Flexinol 100 HT (90°C)
14)	-	1	ea	Plug, Mini, 2.5 mm
15)	-	1	ea	Battery Holder, 3V, 2 x AA, with leads
16)	AA1	1	ea	Wingbase Strip
17)	-	1	ea	Polyester Sheet, Aluminized, 5 mil, 3" x 4-1/2"
18)	-	1	ea	Instructions (these)

For continuous operation use a 3 Volt, 200 mA adapter in place of the battery pack. With other adapters, if the output exceeds 200 mA, use a limiting resistor. Levels over 200 mA can overheat the Muscle Wire and reduce its operating lifetime.

Schematic

The schematic shows the connections of the Space Wings components. For a complete description of their functions and of the overall operation, see Section 4.



2 - Assemble the Circuit Board

The Space Wings Kit demonstrates the amazing capabilities of Muscle Wires®, thin metal filaments that actually SHORTENS IN LENGTH when electrically activated. Review these instructions to become familiar with the parts in the kit. If you have not assembled electronics before, read Section 6 to learn about soldering.

• Bend the leads on the 75KΩ (75,000 ohm) resistors color coded Violet, Green, Orange, Gold and insert into locations R1 and R2 on the Printed Circuit Board (PCB). Bend the leads slightly outwards (F2.2) to hold the part flush against the board and solder in place.

• Bend the 1.6Ω (1.6 ohm) resistor (colored Brown, Blue, Gold, Gold), insert at R3 and solder (F2.3). Trim away excess leads.

• Insert the IC socket into location U1 (F2.4), with the notched end towards the top, as printed on the board. Solder all pins, using care to not bridge any of them with excess solder.

• Insert the 1MΩ (1,000,000 ohm) variable resistor (also called a potentiometer) into location VR1 (F2.5). Bend the leads slightly and solder in place.

• Insert the capacitor into location C1 (F2.6) with the "-" and "+" on the part matching the holes as printed on the board. Solder and trim.

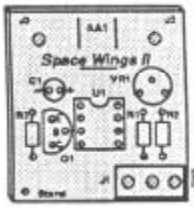
• Insert the 2.5 mm mini jack at J1 (F2.7) and solder.

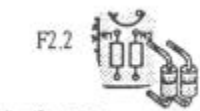
• Insert the transistor into location Q1 (F2.8), with the curved side as indicated on the circuit board. Push in until it stands about one centimeter above the board (F2.9). Solder and trim.

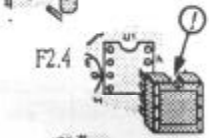
• Insert a screw into J2 from the FRONT of the circuit board, and into J3 from the BACK (F2.9). Secure in place with nuts, but do not tighten until later.

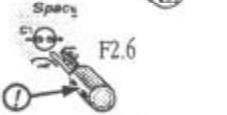
• Inspect the board. All parts should be correctly positioned (especially C1, U1 and Q1). All solder joints should look clean, bright, smooth, and have no holes. There should be no excess solder joining or bridging separate solder points. Heat and remove excess solder and resolder cold joints.

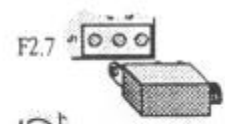
• Straighten the stand wire, insert it at the hole marked "Stand" and solder it in place with an equal

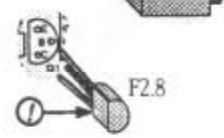


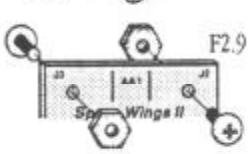




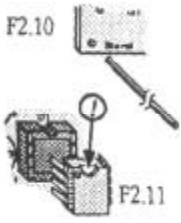








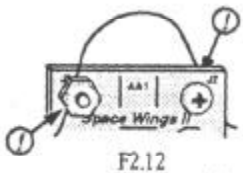
amount extending from both sides of the PCB (F2.10). Bend the wire slightly so it supports the PC board.


F2.10

F2.11

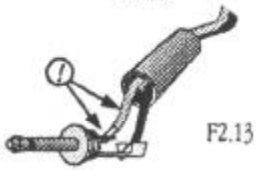
• Insert the Integrated Circuit, the TLC555 Timer in the socket at U1, with pin 1 at the top left (F2.11). Be sure all legs seat properly and do not bend underneath or extend outside the socket.

• Position one end of the Muscle Wire under the hex nut at J2, and the other under the hex nut at J3. Note how the wire arches over the top of the board at AA1. Temporarily secure both the screws, leaving as much slack in the Muscle Wire as possible (F2.12).



F2.12

• Remove the miniplug's cap and thread the Battery Holder wires through the small end first (F2.13). Solder the RED wire (+) to tip and BLACK (-) to the body. Crimp the strain relief, and replace the cap.


F2.13

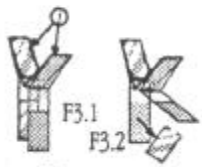
• Install two AA batteries in the battery holder and test the output with a volt meter to be sure the TIP is POSITIVE. Test the circuit by plugging the battery pack (or an 3 Volt, 200 milliamp AC adapter) into J1. After a few moments the Muscle Wire should move slightly. If the wire does not move, remove power. Check the batteries or outlet. Review all steps and look for misplaced parts, bad joints, solder bridges, etc.

If it still does not function, refer to the schematic and use a voltmeter to check for proper input voltage, circuit continuity, and output signal at pin 3 on U1 (Pin 1 is the leg of the IC closest to C1). When everything works correctly, go on to Section 3.

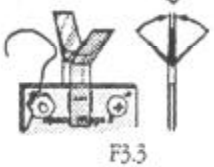
3 - Assemble the Wings

After verifying that the circuit built in Section 2 functions, remove power.

• Loosen one end of the Muscle Wire and move it out of the way. Fold the wing base strip into a "Y" with the CENTER adhesive strips facing UPWARDS (as shown in figure 3.1).


F3.1
F3.2

• Remove the backing from one of the END adhesive strips (F3.2). Press the adhesive tab to the board at location AA1, with the strip extending straight away from the edge. Repeat on the other end, positioning the strip so that when closed, the wing base points straight away from the board (F3.3).


F3.3

• Pass the Muscle Wire through the "Y" of the wing base and position the wire so it just begins to pull the

wing base closed (F3.4). Tighten the screw to hold the wire in place.

- With a hobby knife and straight edge ruler, cut the polyester sheet from corner to corner, and trim the lower corners to make a small flat edge 1 cm (1/2 inch) long (F3.5).

- Remove one backing strip from the center of the wing base. Position a wing with the small flat edge in the wing base's "V" and the longest edge positioned above the stand wire (F3.6). Leaving a small gap between the bottom of the wing and the Muscle Wire (F3.7), press the wing onto the adhesive.

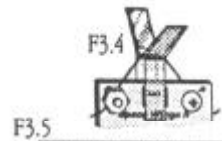
- Attach the second wing, aligning it with the first. Press both wings securely to the adhesive.

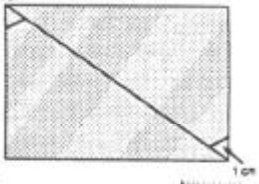
- With a small screwdriver or your fingers, adjust variable resistor VR1 to a middle position (F3.8).

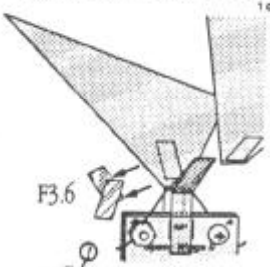
- Plug the battery pack or adapter into the circuit board. Turn VR1 to change the rate of motion.

- The weight of the wings will extend the Muscle Wire. Let the circuit run for a few cycles, then adjust the Muscle Wire so the wings nearly close when up, and relax to about 100° (F3.9). There is a point where it works perfectly - keep trying until you find it. If the wings lean to one side or the other when up, lift one end of the wing base from the board, and raise or lower it until the wings close directly over the board.

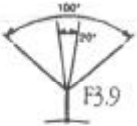
- After operating for a few hours, the wing base mechanism may settle and require slight adjustment. Finally, when completely adjusted, secure the wing base with a piece of transparent tape on each side of the board (F3.10).


F3.4


F3.5

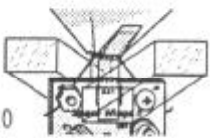

F3.6

F3.7



F3.9

F3.8


F3.10

Depending on the flapping rate set by VR1, the batteries should last for from 5 to 10 hours of continuous operation. Place the complete Space Wings in a well lit location, safe from curious cats and hungry vacuum cleaners.

Plug it in, and watch it go!

Where to put your Space Wings? On a desk lamp. In a potted plant. On a computer monitor. Where the sun shines.

5 - About Muscle Wires

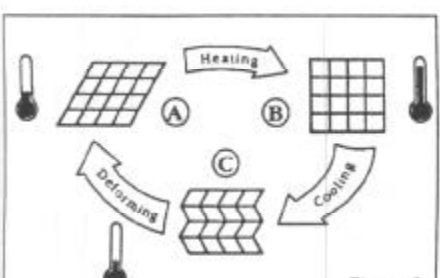


Figure 5

Muscle Wires belong to the class of metals known as Shape Memory Alloys (SMAs) having crystal structures that can assume different shapes at distinct temperatures. At low temperatures (F5.C), Muscle Wires can be easily stretched (F5.A), then when heated they return to their original shape with a usable force and speed (F5.B).

In 1932 Swedish researcher Arne Ölander observed the shape recovery abilities of a gold-cadmium alloy, and noted its potential for creating motion. In 1950, L.C. Chang and T.A. Read, at Columbia University in New York, used X-rays to study the alloy and to understand the phase changes of its crystal structure.

In 1961, while searching for non-corrosive marine alloys, a team led by William Beuhler at the U.S. Naval Ordnance Laboratory (NOL) found the shape memory effect in an alloy of nickel and titanium. They named the alloy nitinol (pronounced "night in all"), an acronym of Nickel, Titanium and NOL. On disclosure of their observations their discovery generated much interest.

During the 1960's and 70's researchers worldwide observed the shape memory effect in various titanium, copper, iron and gold alloys. NASA studied SMAs for applications such as satellite antennas that would expand from the heat of the sun, and other experimenters developed a variety of engines that operated on hot and cold water.

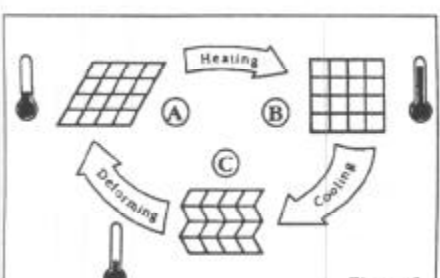
Universities and companies researched SMAs, and some commercial applications resulted. Among the most successful applications, Raychem Corporation introduced a line of SMA pipe connectors that would shrink to fit and provide highly reliable seals for jet engines and hydraulic systems.

In 1986 China hosted the International Symposium on SMAs which saw the presentation of seventy eight papers from fourteen countries. Topics included basic alloy research and development, crystal structures, medical applications, product designs, and manufacturing studies.

Nitinol alloys contains nearly equal amounts of nickel and titanium. Differences of less than one percent can change the transition temperatures by as much as 150°C. Therefore the materials require very careful formulation and processing.

The manufacturer measures the component metals, then melts them together. The cast material is cooled, then rolled and formed into the desired shape. Nitinol's hardness (greater than some steels), and its shape change abilities makes processing difficult and more expensive than similar non-memory metals.

5 - About Muscle Wires



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6 - Assembling Electronics

f you have never assembled electronics you should read about the basics before ou begin. The steps below outline the basic procedures for preparing, soldering and specting many kinds of electronic components. With a few tools and a little atience you will have no trouble assembling, testing and displaying your Space Wings.

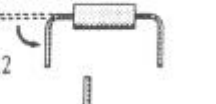
F6.1 - Basic tools needed: Soldering iron, small ponge, electronic solder, needle nose pliers, side cut-rs. Optional: Spare soldering iron tip, flux remover. Plug in the iron, and moisten the sponge with water. hen hot, "tin" the soldering iron's tip with a small nount of solder (replace the tip if old or corroded). ipe the tip across the wet sponge from time to time keep it clean. A clean, well-tinned tip does best.

F6.1

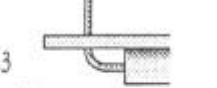
F6.2 - Bend the component leads to fit the holes on e board.

F6.2

F6.3 - Insert the component, observing any special ori-tation it may require. Bend the leads enough to old the part flush against the board, but do not over end.


F6.3

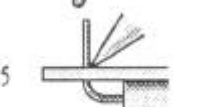
F6.4 - Wipe the tip clean and tin with a small amount solder.


F6.4

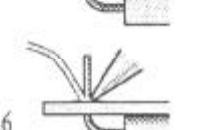
F6.5 - Heat the joint by placing the soldering iron's p against both the component lead and the circuit oard pad.

F6.5

F6.6 - After a moment of heating, touch the solder to e lead, pad and iron. When the solder flows, remove and hold the tip in place for one second. Remove e iron and, without moving the part or board, wait r the joint to cool.


F6.6

F6.7 - Trim excess component lead with the side cut-r. Parts with short leads do not need to be trimmed.


F6.7

Inspect the joint. A good solder joint blends the lead nd pad smoothly together, and has a smooth, bright finish. If the joint bulges or bridges other pads, remelt it, and remove the excess solder with the soldering iron. If the oint looks fuzzy or dull it is a "cold" solder joint. Remelt it, and let it cool (without oving) to a smooth, bright finish.

Optional: After finishing all soldering, you may wish to clean the board to remove ny flux residue. Use a commercial flux remover, and follow its instructions.

When drawn into wires, Nitinol can be easily heated by an electric current, and with additional processing, as with Muscle Wire, the wires can contract and relax for millions of cycles. SMA wires function like electric muscles, and could contribute to robotic and prosthetic devices that would be difficult to make using other methods.

Around the world, interest in Shape Memory Alloys continues to grow, and many frontiers await exploration. We hope Space Wings brings you hours of educational fun, and leads you to new and interesting discoveries of your own.

For more information, see our "Muscle Wires Project Book". Explore amazing new devices from simple levers to complete motorless miniature walking robots. It includes fifteen fascinating hand-on projects, circuits, devices, history, references, software listings and essential secrets for maximum performance. Contact us for our latest product catalog and technical information.:

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Phone 415-491-4600 Fax 415-491-4696 Email info@mondo.com

We fully guarantee the quality and completness of this kit.
If you suspect something is missing, please write to us.

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